

USPTO SN: 10/042,511
Bischoff et al.
Reply to Office Action mailed March 9, 2004

Listing of Claims:

The following listing of claims replaces all prior versions of claims in the application:

1-2. (Cancelled).

3. (Currently amended) ~~The adapter of Claim 1, further comprising:~~ An adapter for coupling a sensor to a fluid line (having at least a first opening) therein, the adapter comprising:

an adapter block having a first fluid channel, a first input port, and a first output port;

a retainer plate coupled to the adapter block, the retainer plate having at least a first opening therethrough;

a first diaphragm having a first membrane portion and a first rim portion surrounding the first membrane portion, the first membrane portion positioned within the retainer plate first opening and the rim portion positioned between at least the adapter block and the retainer plate,

wherein the first diaphragm is held in place by a compression force exerted between the adapter block and the retainer plate;

a second fluid channel, a second input port, and a second output port formed in the adapter block;

a second opening formed through the retainer plate; and

a second diaphragm having a second membrane portion and a second rim portion surrounding the second membrane portion, the second membrane portion positioned within the retainer plate second opening and the second rim portion positioned between at least the adapter block and the retainer plate,

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wherein the second diaphragm is held in place by a compression force exerted between the adapter block and the retainer plate.

- 2 4. (Original) The adapter of Claim 3, further comprising:
a second spacer element coupled within the second output port, the second spacer element having a third fluid channel including a third input port and a third output port, the third input port in fluid communication with the second fluid channel and the second output port adapted for coupling with a sensor.
- 3 5. (Currently amended) The adapter of Claim 4, wherein, the first diaphragm is formed of the same material as the adapter block.
- 4 6. (Original) The adapter of Claim 5, wherein:
the first membrane includes a plurality of convolutions on one or more surfaces thereof.
- 5 7. (Original) The adapter of Claim 3, wherein the second diaphragm is formed of the same material as the adapter block.
- 6 8. (Original) The adapter of Claim 3, wherein:
the second membrane includes a plurality of convolutions on one or more surfaces thereof.
- 7 9. (Currently amended) The adapter of Claim 4, wherein the first diaphragm is formed of different material than the adapter block.

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8 10. (Original) The adapter of Claim 3, wherein the second diaphragm is formed of different material than the adapter block.

9 11. (Currently amended) The adapter of Claim 4 ~~2~~ wherein: the fluid line includes a fluid input port and a fluid output port and a flow bore extending from the fluid input port to the fluid output port.

10 12. (Original) The adapter of Claim 11 wherein: the flow bore of the fluid line includes an integral flow orifice.

11 13. (Original) The adapter of Claim 11 ⁹ wherein: the flow bore of the fluid line includes an integral flow venturi.

12 14. (Original) The adapter of Claim 11 ⁹ wherein: the bore of the fluid line is a substantially straight bore.

13 15. (Currently amended) The adapter of Claim 4 ~~3~~ wherein: the one or more membranes includes a plurality of convolutions on one or more surfaces thereof.

16. (Cancelled).

14 16. (Currently amended) An adapter for coupling a sensor to a fluid system, comprising:
a fluid line including a fluid input port, a fluid output port, and a flow bore extending from the fluid input port to the

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fluid output port, the fluid line further including at least a first opening extending from the flow bore to a surface of the fluid line between the fluid input port and fluid output port thereof;

an isolator block having at least a first cavity and having a second cavity formed in a surface of the isolator block therein, wherein the surface of the isolator block is coupled to the surface of the fluid line such that and the second cavity is in fluid communication with the adapted for fluidly coupling to a first opening in the fluid line; and

a first flexible membrane integrally formed in as part of the isolator block and physically separating the first cavity from the second cavity, wherein the first flexible membrane transfers a pressure between the second cavity and first cavity.

18. (Cancelled).

15 19. (Currently amended) The adapter of Claim 18 17 wherein:
the first flexible membrane is integrally molded with the isolator block. ¹⁴

16 20. (Currently amended) The adapter of Claim 18 17 wherein:
the first flexible membrane is integrally machined into the isolator block. ¹⁴

17 21. (Currently amended) The apparatus of Claim 18 17 wherein:
the first flexible membrane includes a plurality of convolutions on one or more surfaces thereof. ¹⁴

22. (Cancelled).

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- 18 23. (Currently amended) The adapter of Claim 23 ¹⁴ 17 wherein:
the flow bore of the fluid line includes an integral flow
orifice.
- 19 24. (Currently amended) The adapter of Claim 22 ¹⁴ 17 wherein:
the flow bore of the fluid line includes an integral flow
venturi.
- 20 25. (Currently amended) The adapter of Claim 22 ¹⁴ 17 wherein:
the flow bore of the fluid line is a substantially straight
bore.
26. (Cancelled).
- 21 27. (Currently amended) The adapter of Claim 18 ¹⁴ 17, further
comprising:
a third cavity and a fourth cavity formed in the isolator
block, the fourth cavity adapted for fluidly coupling to a
second opening in the fluid line; and
a second membrane integrally formed as part of the isolator
block and physically separating the third cavity and the fourth
cavity.
- 22 28. (Original) The adapter of Claim 21 wherein:
the second membrane is integrally molded with the isolator
block.
- 23 29. (Original) The apparatus of Claim 21 wherein:
the second membrane is integrally machined into the
isolator block.

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30. (Original) The adapter of Claim 21 wherein:

the second membrane includes a plurality of convolutions on one or more surfaces thereof.

31. (Cancelled).

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32. (Currently amended) An adapter for coupling a sensor to a fluid system, comprising:

a fluid line including a fluid input port, a fluid output port, and a flow bore extending from the fluid input port to the fluid output port, the fluid line further including at least a first opening extending from the flow bore to a surface of the fluid line between the fluid input port and fluid output port thereof;

an isolator block having at least a first cavity and having a second cavity formed in a surface of the isolator block therein, wherein the surface of the isolator block is coupled to the surface of the fluid line such that and the second cavity is in fluid communication with the adapted for fluidly coupling to a first opening in the fluid line;

a first membrane integrally formed in as part of the isolator block and physically separating the first cavity from the second cavity, wherein the first membrane transfers a pressure between the second cavity and first cavity;

a first spacer element having one or more openings extending therethrough from a first surface to a second surface, the first spacer element coupled within the first cavity such that one of its first and second surfaces is positioned proximate the first membrane; and

a sensor in fluid communication with one of the openings in the first spacer element.

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- 26 33. (Original) The adapter of Claim 32 wherein:
the first membrane is integrally molded with the isolator
block.
- 27 34. (Original) The adapter of Claim 32 wherein:
the first membrane is integrally machined into the isolator
block.
- 28 35. (Original) The adapter of Claim 32 wherein:
the first membrane includes a plurality of convolutions on
one or more surfaces thereof.
- 29 36. (Original) The adapter of Claim 32 wherein:
the sensor comprises a pressure sensor.
37. (Cancelled).
- 30 36. (Original) The adapter of Claim 37 wherein:
the flow bore of the fluid line includes an integral flow
orifice.
- 31 39. (Original) The adapter of Claim 37 wherein:
the flow bore of the fluid line includes an integral flow
venturi.
- 32 40. (Original) The adapter of Claim 37 wherein:
the flow bore of the fluid line is a substantially straight
bore.
- 33 41. (Original) The adapter of Claim 32 wherein:

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another one of the first and second openings of the first spacer element is a fill port for inserting a pressure transmission fluid.

- 34 42. (Original) The adapter of Claim 32, further comprising:
a third cavity and a fourth cavity formed in the isolator block, the fourth cavity adapted for fluidly coupling to a second opening in the fluid line; and
a second membrane integrally formed as part of the isolator block and physically separating the third cavity and the fourth cavity.

- 35 43. (Original) The adapter of Claim 42 wherein:
the second membrane is integrally molded with the isolator block.

- 36 44. (Original) The adapter of Claim 42 wherein:
the second membrane is integrally machined into the isolator block.

- 37 45. (Original) The adapter of Claim 42 wherein:
the second membrane includes a plurality of convolutions on one or more surfaces thereof.

- 38 46. (Original) The adapter of Claim 42, further comprising:
a second spacer element having one or more openings extending therethrough from a third surface to a fourth surface, the second spacer element coupled within the third cavity such that one of its third and fourth surfaces is positioned proximate the second membrane,

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wherein the sensor is in fluid communication with one of the openings in the second spacer element.

5941. (Original) An apparatus for sensing one or more physical characteristics of a fluid, comprising:

a fluid line including a fluid input port, a fluid output port, and a flow bore extending from the fluid input port to the fluid output port, the fluid line further including a first opening and a second opening spaced apart from the first opening, each of the first and second openings extending from the flow bore to a surface thereof

an isolator block having at least a first cavity, a second cavity, a third cavity and a fourth cavity formed therein, the second cavity and fourth cavity each adapted for fluidly coupling to the first opening and a second opening, respectively, in the fluid line;

a first membrane integrally formed as part of the isolator block and physically separating the first cavity from the second cavity;

a second membrane integrally formed as part of the isolator block and physically separating the third cavity from the fourth cavity;

a first spacer element having one or more openings extending therethrough from a first surface to a second surface, the first spacer element coupled within the first cavity such that one of its first and second surfaces is positioned proximate the first membrane;

a second spacer element having one or more openings extending therethrough from a third surface to a fourth surface, the second spacer element coupled within the third cavity such

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that one of its third and fourth surfaces is positioned proximate the second membrane; and

a sensor in fluid communication with one of the openings in the first spacer element and in fluid communication with one of the openings in the second spacer element.

48-63. (Cancelled).

40 64. (Currently amended) An apparatus for sensing one or more physical characteristics of a fluid, comprising:

an isolator plate having at least a first cavity formed therein adapted for fluidly coupling to a first opening in a fluid line and a second cavity formed therein ~~adapter adapted~~ for fluidly coupling to a second opening in the fluid line;

at least a first membrane integrally formed as part of the isolator plate and positioned proximate one end of the first cavity and at least a second membrane integrally formed as part of the isolator plate and positioned proximate one end of the second cavity;

an adapter plate coupled to the isolator plate, the adapter plate having a first fluid channel having a first input port in fluid communication with the first membrane and a first output port, the adapter plate including a third fluid channel having a third input port in fluid communication with the second membrane and a third output port;

a first spacer element coupled within the first output port, the first spacer element having a second fluid channel including a second input port in fluid communication with the first fluid channel and a second output port;

a second spacer element coupled within the third output port, the second spacer element having a fourth fluid channel

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including a fourth input port in fluid communication with the third fluid channel and a fourth output port adapted for coupling with the sensor; and

a sensor in fluid communication with the second output port and the fourth output port.

4165. (New) An apparatus for sensing a physical state of fluid which flows at least from a first point to a second point along a fluid line, comprising:

an isolator block having a first cavity formed in a surface of the isolator block, wherein the surface of the isolator block is coupled to a surface of the fluid line such that the first cavity is disposed over a first opening in the fluid line which is located on the surface of the fluid line between the first and second points of the fluid line;

a first membrane formed in the first cavity of the isolator block, wherein a pressure from the fluid line is transferred across the first membrane; and

a sensor having a first inlet coupled to a first outlet of the isolator block which is connected by a first channel to a surface of the first membrane opposite from the fluid line.

4266. (New) The apparatus of claim 65, wherein the isolator block further includes a second cavity formed in the surface of the isolator block and disposed over a second opening in the fluid line along the surface of the fluid line between the first and second points of the fluid line.

4367. (New) The apparatus of claim 66, further including a second membrane formed in the second cavity of the isolator block.

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44⁶⁸. (New) The apparatus of claim ⁴³ 67, wherein the sensor has a second inlet coupled to a second outlet of the isolator block which is connected by a second channel to a surface of the second membrane opposite from the fluid line.

45⁶⁹. (New) The apparatus of claim ⁴¹ 65, further including an adaptor block coupled between the isolator block and the sensor.

46⁷⁰. (New) The apparatus of claim ⁴¹ 65, wherein the first surface of the isolator block and the surface of the fluid line are substantially flat.